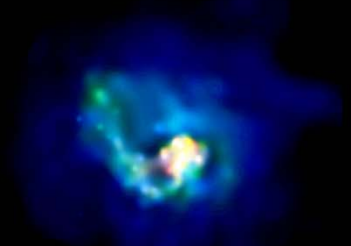
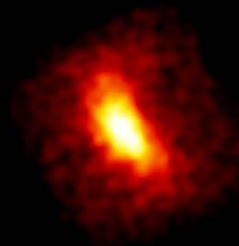
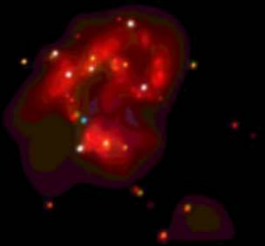




Constellation

The Constellation X-ray Mission

► **SXT Alignment and Test Status**
February 15, 2005



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Scott.Owens@nasa.gov

Alignment and Test Overview

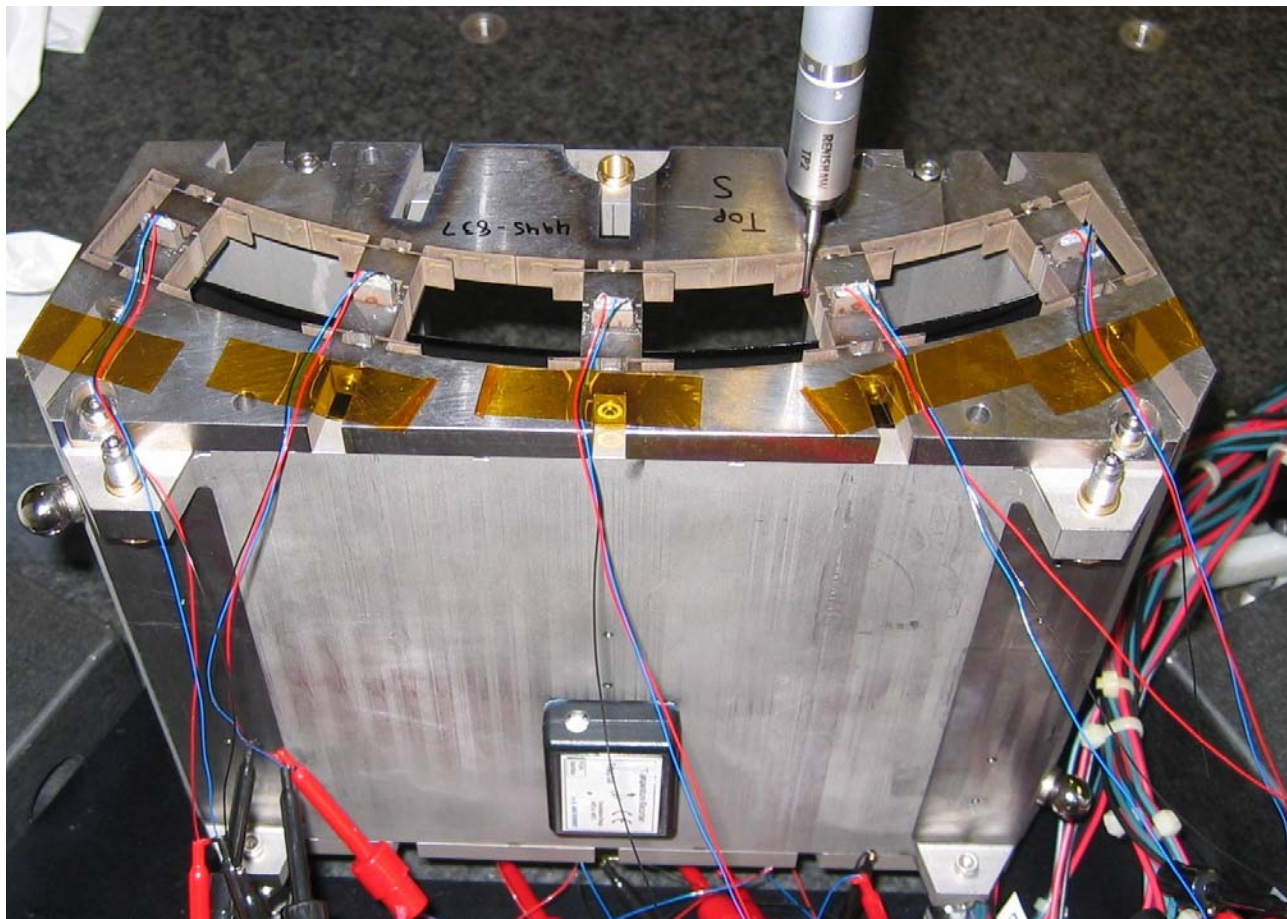
- **Original 18 month Alignment and Test Plan**
 - Long term alignment and test plan developed in May/June '05
 - In-lab single mirror segment alignment demonstration
 - Single mirror segment pair alignment held in quasi-flight like mount
 - Tentative plan for x-ray test, January '06
 - Multiple mirror segment pair (i.e., multiple shells) alignment and x-ray imaging test at MSFC, August/September '06
- **Progress so far - Single mirror segment pair alignment and test**
 - Performance prediction based on visible mirror segment area near requirements
 - Only 1/4 of mirror segment visible - is the rest of the mirror performing as well?
 - Alignment housing modifications performed, re-alignment underway
- **Plans under new budget constraints**
 - Continue alignment and mirror segment figure studies
 - Delay x-ray imaging test pending budget recovery

Single mirror segment pair alignment process

- **Align a single mirror segment pair using a series of successively more accurate tools**
 - Contact Coordinate Measuring Machine
 - Collimated visible light focusing (ASTRO-E alignment facility)
 - Centroid Detector Assembly (CDA) to measure local slope angle and normal incidence, full aperture interferometry to measure mirror figure
 - Take mirror figure and focusing data from alignment process and predict the imaging quality, taking into account 1-g effects due to the horizontal orientation of the test
- **Bond mirror segments into a test housing and perform an image test at 1.5 keV at the Stray Light Facility at MSFC**
 - Bond mirror segments while monitoring the focusing and figure with CDA and interferometry
 - Perform x-ray imaging test
 - Correlate performance prediction with experimental x-ray test to verify our optical and mechanical models

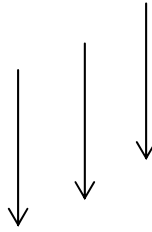
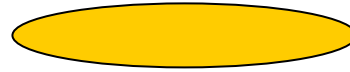
Initial alignment with contact Coordinate Measuring Machine (CMM)

- Contact probe used to measure the radial position at 5 points along the top and bottom of the mirror segment
 - Flexures holding mirror are adjusted with precision set screws, while CMM monitors radial positions

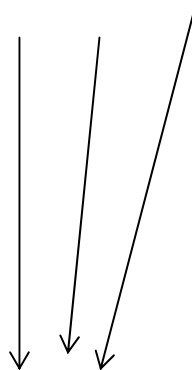
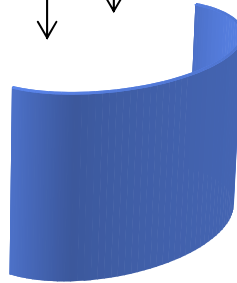


Further alignment is carried out collimated using white light

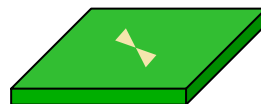
Collimated white
light source



Mirror or pair

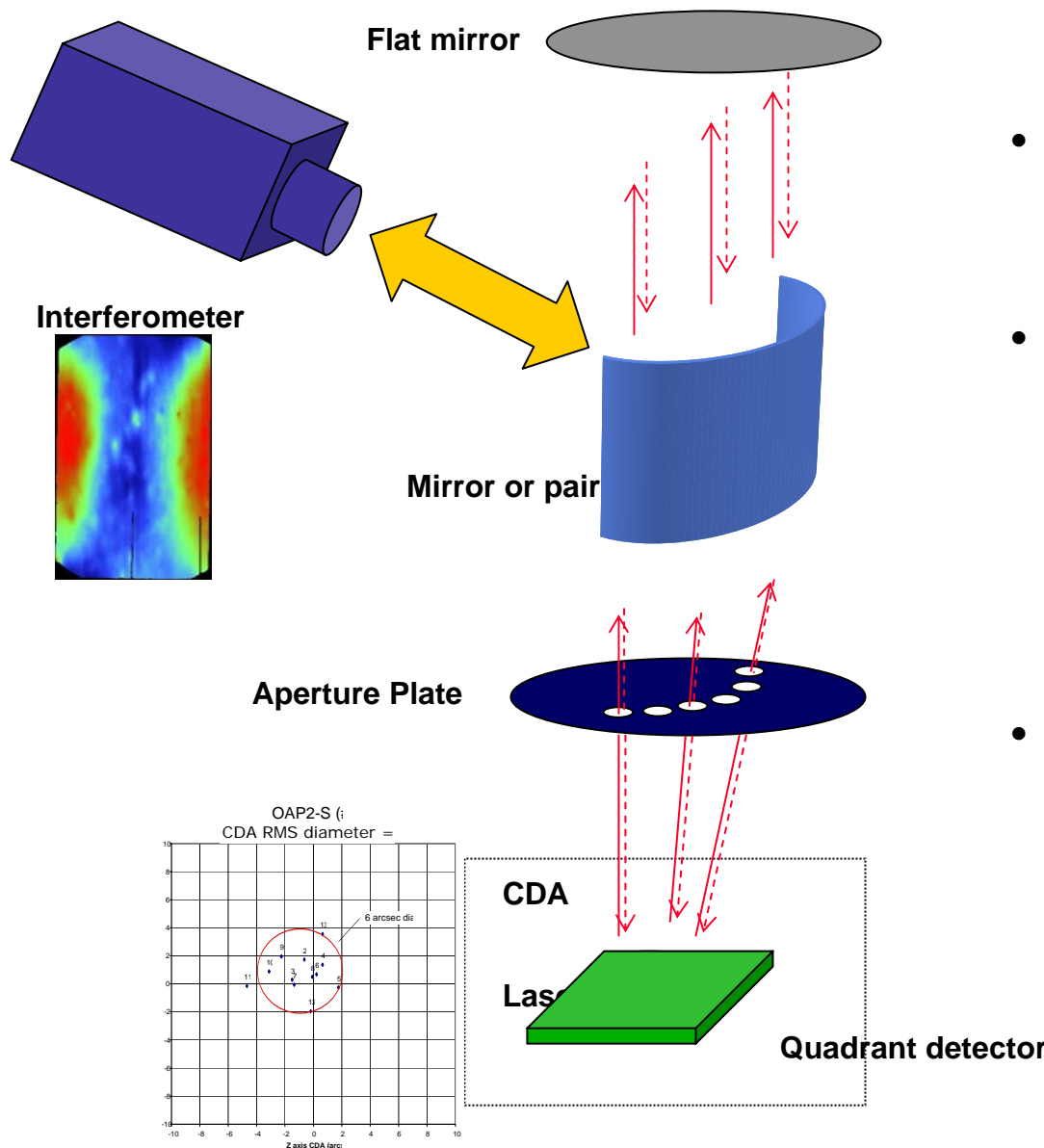


Optical CCD



- Method used for aligning ASCA, Astro-E mirrors
- Illuminate full segment using collimated beam
- Image onto CCD
- Images on and off focus provide useful information
- Align by inspecting image quality

Centroid Detector Assembly allows high resolution alignment

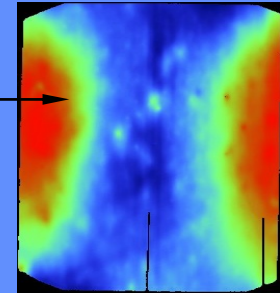


- CDA originally developed for aligning AXAF mirrors (<0.1 arc second accuracy)
- CDA samples only a portion of surface, defined by aperture stops; only locates centroid of return beam
- No information about axial curvature
- Only way to determine shape of segment is simultaneous profile measurement using interferometer

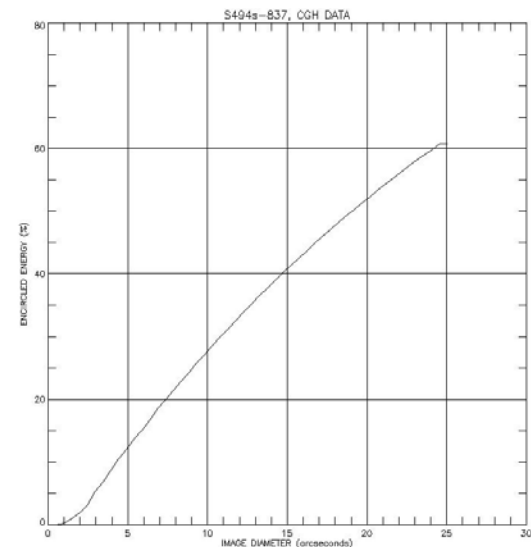
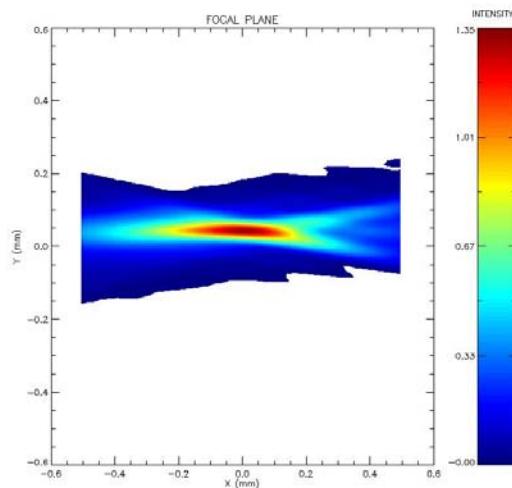
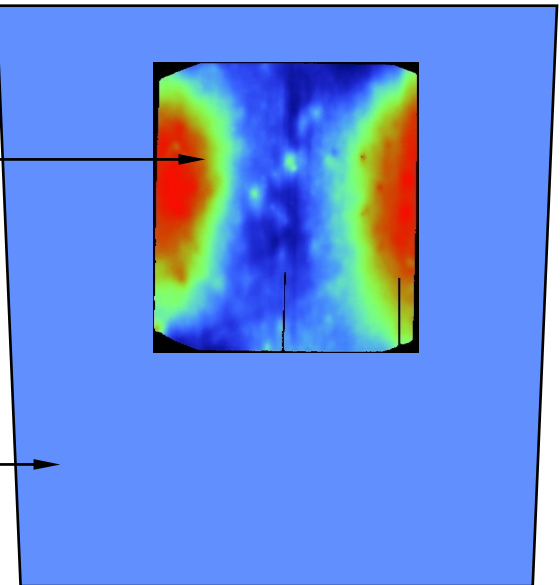
Uncertainties

- Performance prediction based on fitting data from visible area of mirror segment
 - HPD = 12.1"-12.8" for single mirror segment
- But, how does the remainder of the mirror segment look?

Visible area



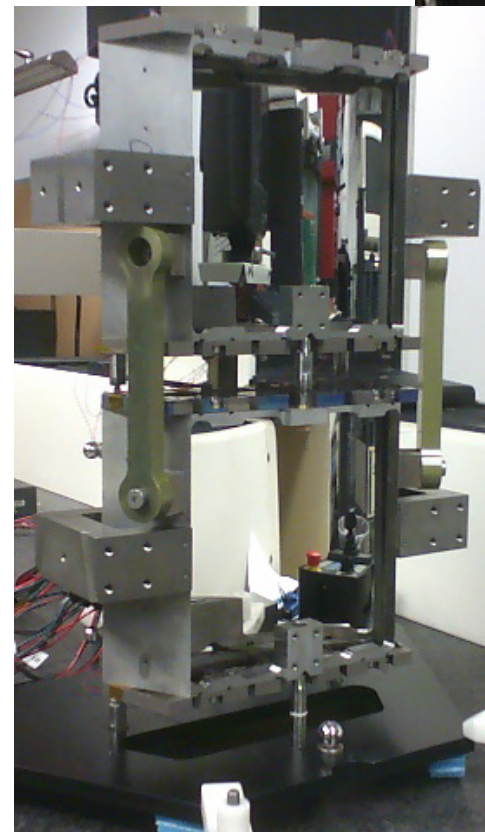
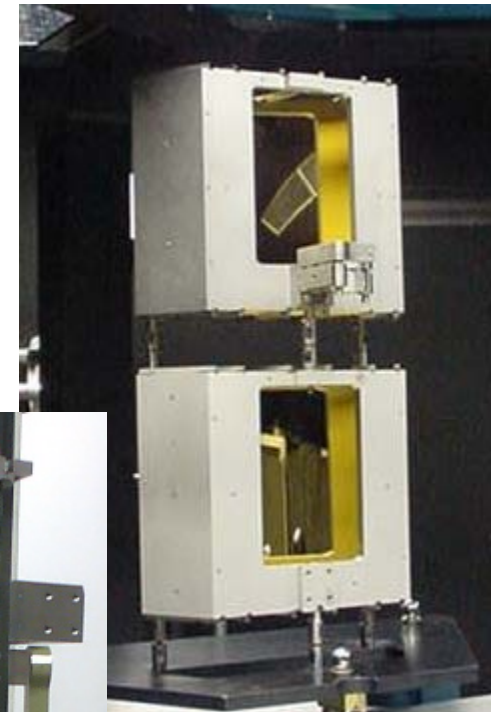
Mirror segment



Alignment housing modifications

- Opened up front face of alignment housings to allow nearly full access for normal incidence interferometry
- Old window
 - 27 degrees wide x 150 mm tall
- New window
 - 50 degrees wide x 190 mm tall
- Mirror segments
 - 50 degrees wide x 200 mm tall
- New metrology optic - conical refractive null lens
 - Can cover 36 degrees x 200 mm tall
 - 2 data sets cover entire mirror segment
- Housings have been re-integrated, and alignment process begun again
 - Constrained funds due to FY '06 re-allocation will delay x-ray imaging tests

Old OAP2 housing



New OAP2 housing

Future plans

- Continue to use the OAP2 platform as an alignment and mounting study tool
- Study gravity sag in the vertical orientation
- Develop a mirror response matrix of mounting/alignment deformations
- Study rigid body rotational and translational imaging errors
 - How do small errors in mirror segment cutting translate into imaging errors
- Refine performance prediction software, based on data available from full aperture mapping tools